Carbon-Pricing Instruments

EES 3310/5310

Global Climate Change

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Perspectives on Market-Based Regulations

Market-Based Regulations

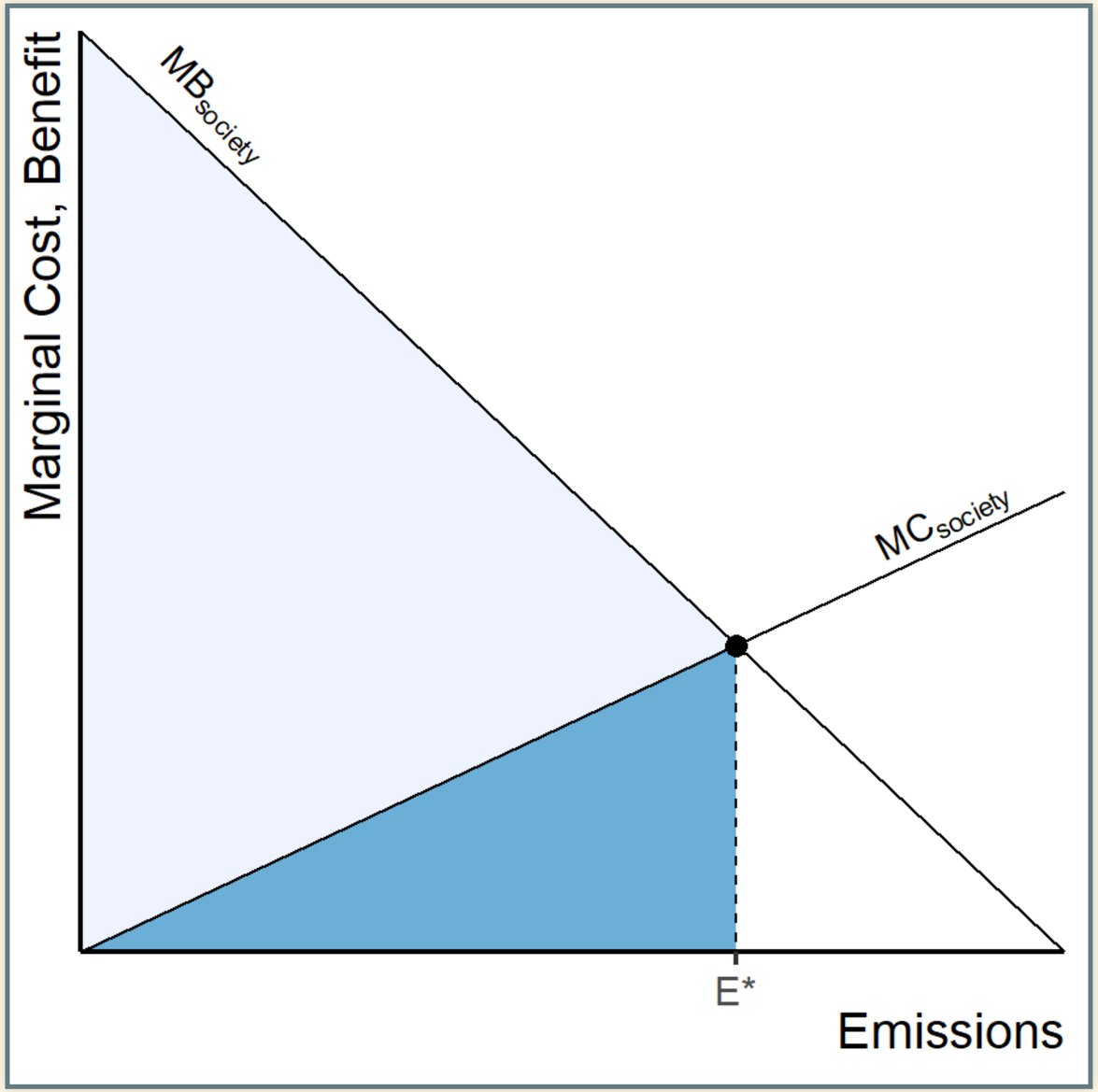
- Most economists (liberal & conservative) favor putting a price on greenhouse gas emissions.
  - **Cap-and-trade:**
    - Require a permit for every ton of fossil fuels
    - Issue a limited number of permits
    - Companies can buy and sell permits
  - **Carbon tax:**
    - Charge a tax on every ton of fossil fuels
    - Price equal to social cost of carbon emissions
  - In principle, cap-and-trade and carbon tax are equivalent if costs and benefits are known accurately.
    - M. Weitzman, 1974. “Prices vs. Quantities,” *Rev. Econ. Studies* **41**, 477–491. https://doi.org/10.2307/2296698
    - Different consequences for inaccuracies in costs or benefits.

Considerations about Market-Based Regulations

- They work best when the total amount of pollution matters, but it doesn't matter who emits it, or where.
  - The impact is spread over large areas, regardless where the emissions happen.
  - Not appropriate when the biggest effects are local: lead pollution, mercury from power plants, urban smog, …
- They work best when it's easy to monitor pollution and track the sources.
  - Sulfur pollution (acid rain) was emitted from large power plants and factories.
  - CO_2 from fossil fuels: fossil fuel production is already well-monitored
    - If we had to monitor every car's tailpipe, it wouldn't work.
  - Doesn't work for illegal dumping (pouring motor oil down sewer drains)
  - The largest source of dioxin (a dangerous cancer-causing chemical) is people in rural areas burning plastic trash in their back yards
- Market-based regulations do not address the distribution of costs and benefits:
  - One group may pay most of the costs and another may enjoy most of the benefits.
  - The distribution of costs may be regressive, with low-income people paying a disproportionate share.

Optimum Emissions Abatement

- Optimum emissions = E^*
- EPA issues permits for E^* tons of emissions
- Free-trading in permits reduces emissions to E^* at minimal cost
- Total net benefits are maximized



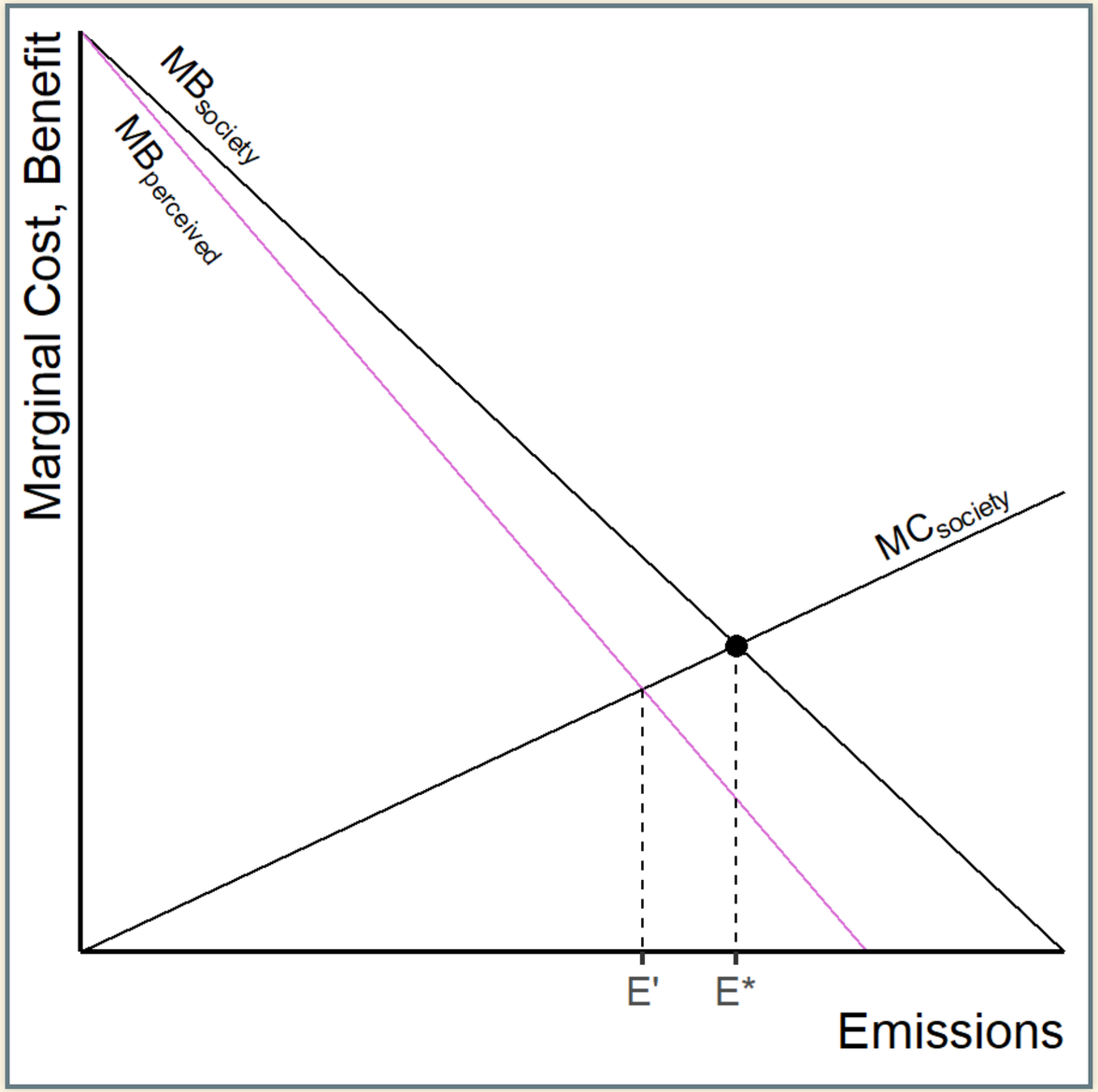
Uncertainty and Errors

Market-Based Regulations and Uncertainty

- Cap-and-trade:
  - Maximum quantity of pollution is known
  - Cost to polluters is uncertain
- Emissions taxes
  - Cost to polluters is known
  - Quantity of pollution is uncertain

Imperfect Emissions Abatement

- Optimum emissions = E^*
- EPA underestimates benefits of emissions (cost of cutting emissions)
  - Issues permits for E’ instead of E^*



Deadweight Losses

- Optimum emissions = E^*
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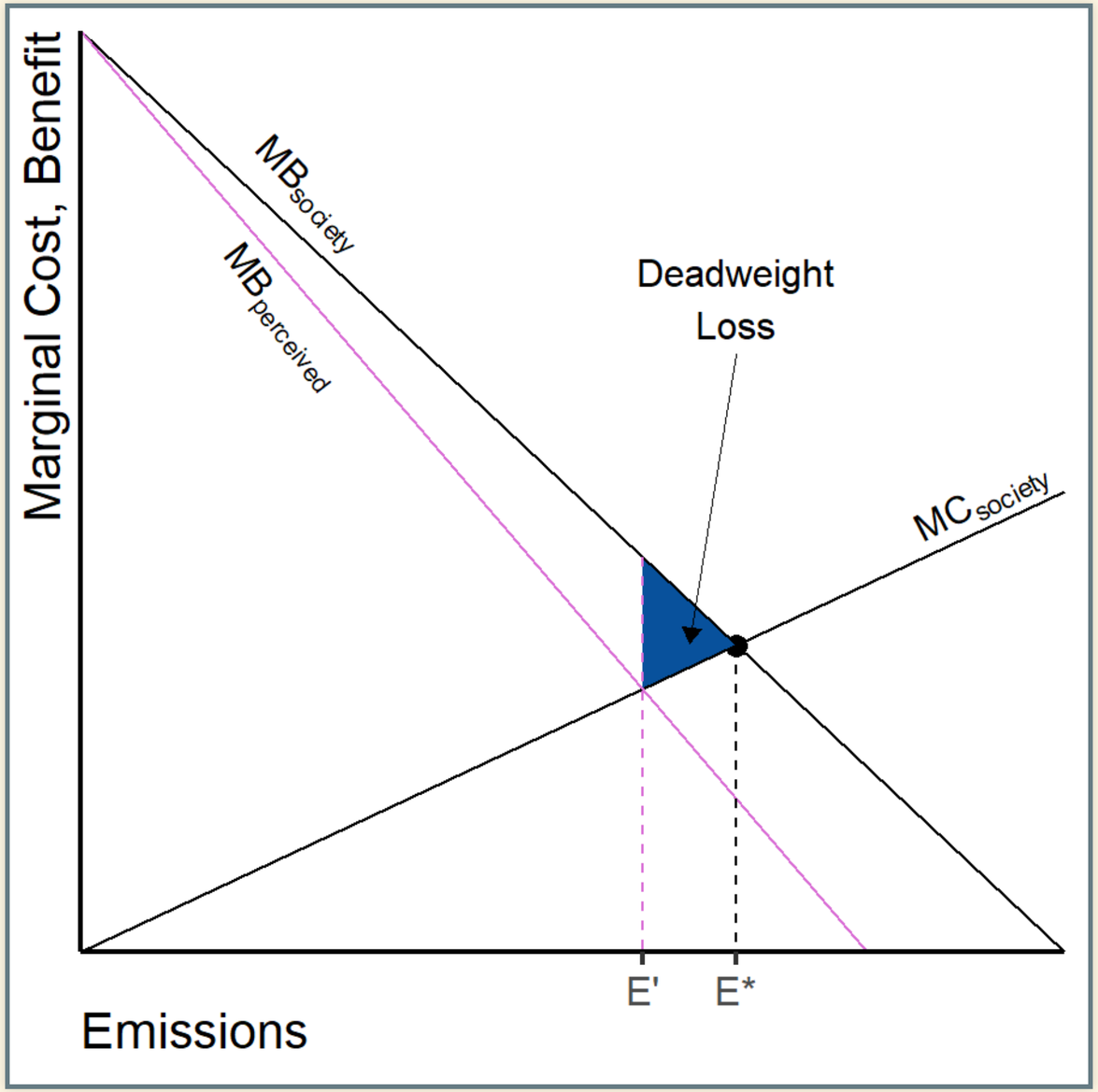
- Deadweight loss (blue triangle) = difference between **actual net benefit** and **optimum net benefit**.



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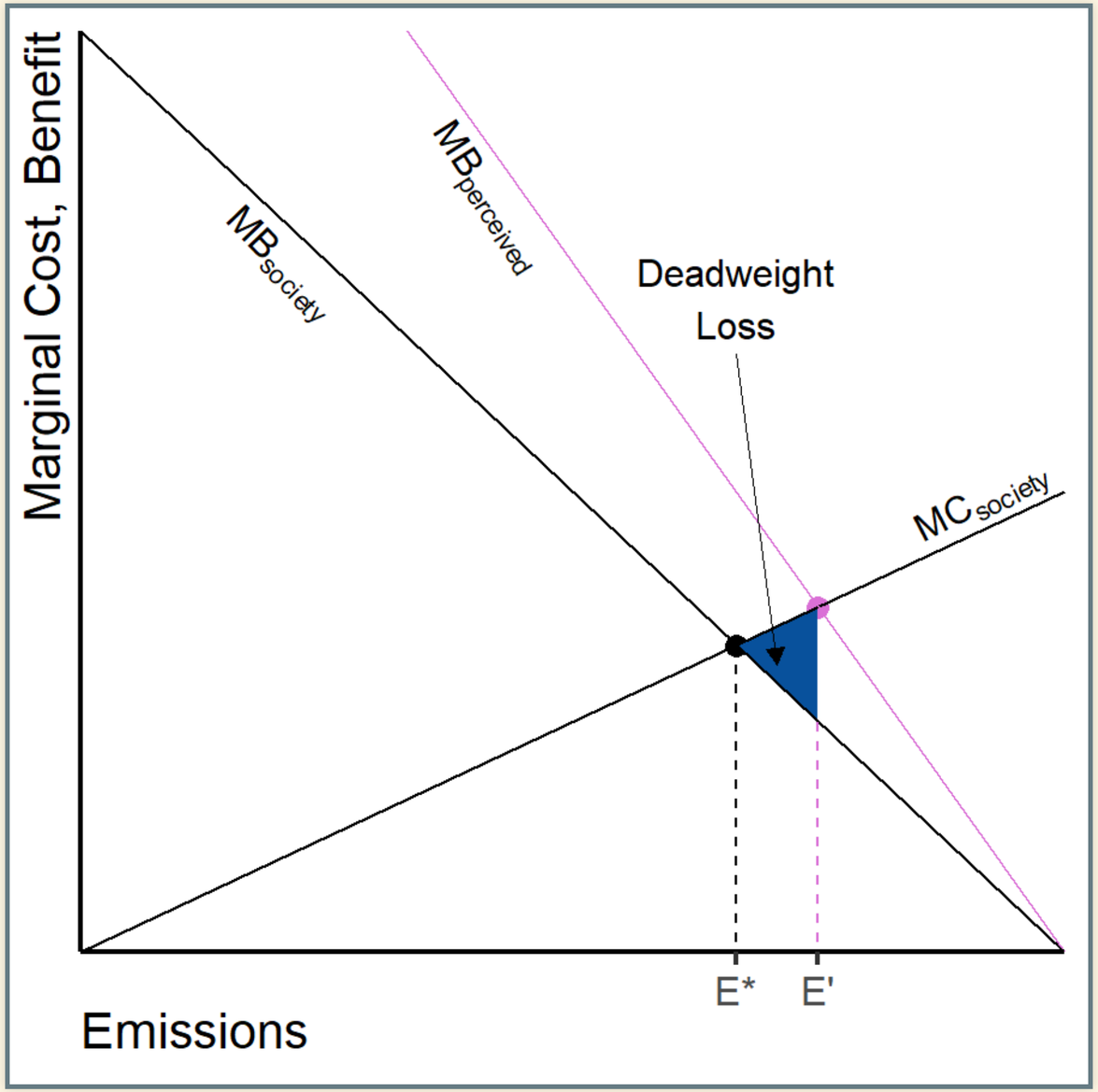
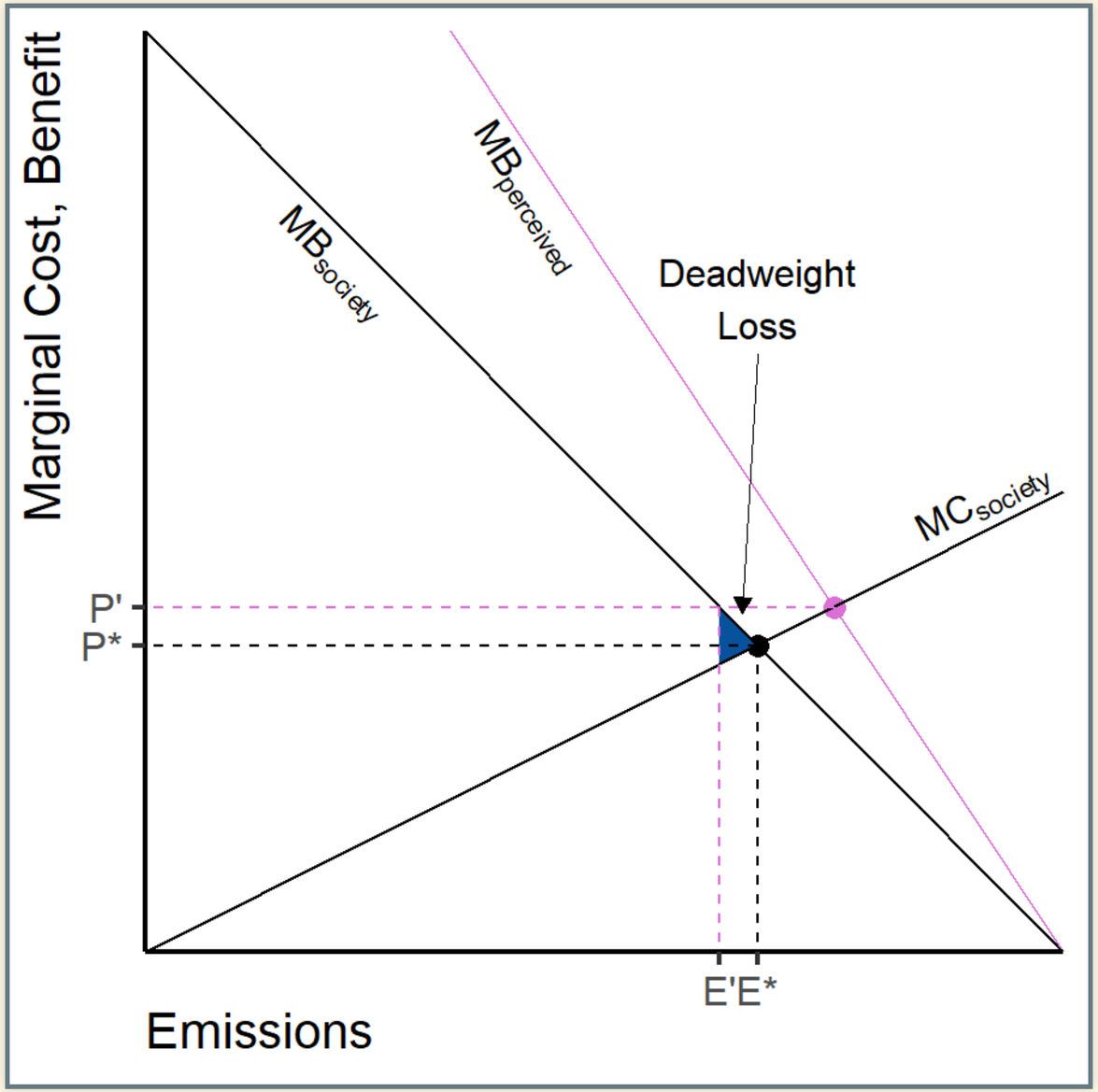


Deadweight Loss with Carbon Tax

- Optimum emissions = E^*
  - This corresponds to a price P^*
- EPA overestimates benefits of emissions (cost of cutting emissions)
  - Sets the price at P’ instead of P^*
  - Actual emissions are where the price P’ intersects the actual benefit curve
- When benefit curve is linear and steeper than the cost curve, then taxes produce better results under uncertainty
  - Taxes may be worse if:
    - The cost curve is steeper than the benefit curve
    - or if the benefit or cost curve is sharply nonlinear near the optimum



Market-Based Regulations in Action

1990 Clean Air Amendments

- Acid rain, mostly from sulfate and nitrate chemicals emitted by burning coal
- Market-based regulation (cap-and-trade)
  - Permits sold at auction
  - Companies could buy and sell permits with each other
- Environmentalists complained about selling the right to pollute
- Industry groups worried permits would be too expensive

How Things Went

- Plan:
  - Gradually reduce emissions by 37% during 1990s
  - Big reductions start in 2000 to reduce pollution 70%
- Predicted costs:
  - Industry:
    - Regulation would cost $3–7 billion per year in 1990s,
    - $7–25 billion per year after 2000
  - EPA:
    - $1.9–5.5 billion per year
- Actual costs:
  - $0.8 billion per year during 1990s
  - $1 billion per year after 2000.
  - Emission reductions met 1999 goals in 1995, four years ahead of schedule.

Broader Patterns in Environmental Regulation

- An economic study of the costs of environmental regulations found:
  - 50% cost at least 25% less than predicted
  - 40% cost roughly as much as predicted
  - 10% cost at least 25% more than predicted
- A 2017 audit of the Clean Air Act by the Office of Management and Budget under President Donald Trump found that out of 55 clean-air regulations they studied,
  - 46 had benefits that were greater than the costs
  - Only 2 had costs greater than the benefits.
- A 2003 report from the Office of Management and Budget under President George H.W. Bush found that clean-air regulations produced benefits between 3 and 4 times greater than the costs of compliance.

Discuss different approaches to policy

Emissions Trading In Detail

Emissions Trading In Detail

- What is the optimum amount of emissions?
- What is the total (gross) cost of emissions?
- What is the total (gross) benefit to society?
- What is the net benefit?

CO_2 emissions	Marginal cost	Marginal benefit
0	—	—
1	20	120
2	40	90
3	60	60
4	80	30
5	100	0

Marginal and Cumulative Costs & Benefits

CO_2 emissions	Marginal cost	Marginal benefit	Gross cost	Gross benefit	Net benefit
0	—	—	0	0	0
1	20	120	20	120	100
2	40	90	60	210	150
3	60	60	120	270	150
4	80	30	200	300	100
5	100	0	300	300	0

- Gross (cumulative) costs and benefits are the sum of marginal costs and benefits from zero to the current level.
- Net benefit is the gross benefit minus the gross cost.
- What is the optimal number of permits to issue?
- What is the optimal emissions tax?

Two Companies

Emissions	MB
0	—
1	100
2	80
3	60
4	40
5	20

Emissions	MB
0	—
1	125
2	100
3	75
4	50
5	25

Emissions	MC
0	—
1	20
2	40
3	60
4	80
5	100
6	120
7	140
8	160
9	180
10	200

Two Companies

Emissions	Company	MB	MC	Gross Benefits	Gross Costs	Net Benefits
1	B	125	20	125	20	105
2	A	100	40	225	60	165
3	B	100	60	325	120	205
4	A	80	80	405	200	205
5	B	75	100	480	300	180
6	A	60	120	540	420	120
7	B	50	140	590	560	30
8	A	40	160	630	720	-90
9	B	25	180	655	900	-245
10	A	20	200	675	1100	-425

- Benefits depend on which company produces the emissions
- Costs only depend on the total emissions
- Put emissions in descending order of marginal benefit.
- What is the optimum emissions level?
- What is the optimum emissions tax?